



# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Pelrine, et al.

Attorney Docket No.: SRI1P028/4431-2

Application No.: 09/779,203

Examiner: To Be Assigned

Filed: February 7, 2001

Group: 2858

4 / IDS  
E. Willis  
8-14-01

Title: MONOLITHIC ELECTROACTIVE  
POLYMERS

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I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail to: Commissioner for Patents, Washington, DC 20231 on August 6, 2001.

Signed:

*Deborah Neill*  
Deborah Neill

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Commissioner for Patents  
Washington, DC 20231

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The references listed in the attached PTO Form 1449, copies of which are attached, may be material to examination of the above-identified patent application. Applicants submit these references in compliance with their duty of disclosure pursuant to 37 CFR §§1.56 and 1.97. The Examiner is requested to make these references of official record in this application.

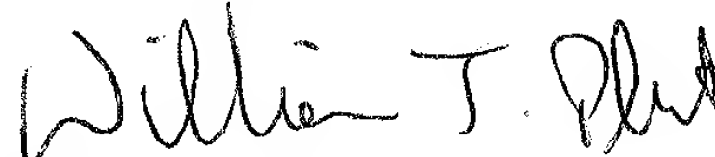
This Information Disclosure Statement is not to be construed as a representation that a search has been made, that additional information material to the examination of this application does not exist, or that these references indeed constitute prior art.

This Information Disclosure Statement is: (i) filed within three (3) months of the filing date of the above-referenced application, (ii) believed to be filed before the mailing date of a first Office Action on the merits, or (iii) believed to be filed before the mailing of a first Office Action after the filing of a Request for Continued Examination under §1.114. Accordingly, it is

believed that no fees are due in connection with the filing of this Information Disclosure Statement. However, if it is determined that any fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 500388 (Order No. SRI1P028).

Respectfully submitted,

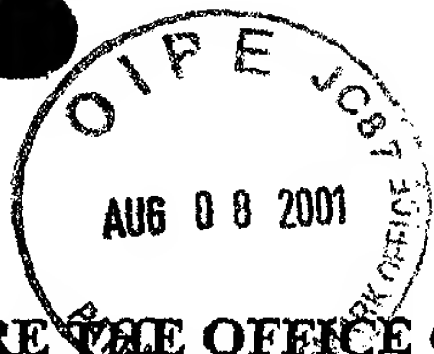
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A handwritten signature in black ink, appearing to read "William J. Plut". The signature is written in a cursive, slightly stylized font.

William J. Plut

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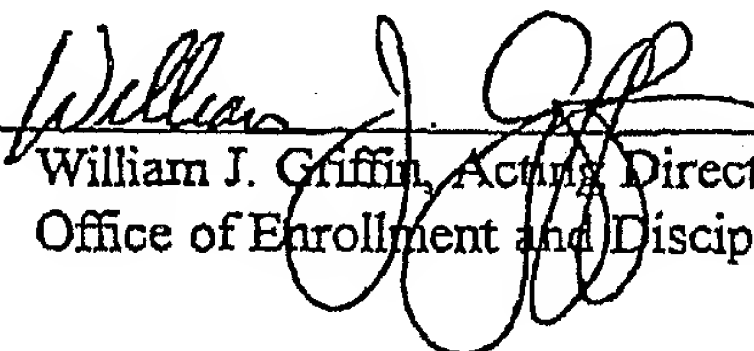
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Expires: June 10, 2002

  
William J. Griffin, Acting Director  
Office of Enrollment and Discipline

Form 1449 (Modified)

**Information Disclosure  
Statement By Applicant**

(Use Several Sheets if Necessary)

AUG 08 2001

 Atty Docket No.  
**SRI1P028/4431-2**

 Application No.:  
**09/779,203**

 Applicant:  
**Pelrine, et al.**

 Filing Date  
**02/07/01**

 Group  
**2858**

**U.S. Patent Documents**

Examiner Initial	No.	Patent No.	Date	Patentee	Class	Sub-class	Filing Date
	A	6,048,622	04/11/00	Hagood, <i>et al.</i>			02/09/99
	B	5,915,377	06/29/99	Coffee			01/24/97
	C	5,902,836	05/11/99	Bennet, <i>et al.</i>			08/23/95
	D	5,835,453	11/10/98	Wynne, <i>et al.</i>			05/05/97
	E	5,642,015	06/24/97	Whitehead, <i>et al.</i>			05/01/95
	F	5,430,565	07/04/95	Yamanouchi, <i>et al.</i>			06/02/93
	G	5,254,296	10/19/93	Perlman			11/13/91
	H	5,250,784	10/05/93	Muller, <i>et al.</i>			10/24/91
	I	5,229,979	07/20/93	Scheinbeim, <i>et al.</i>			12/13/91
	J	5,024,872	06/18/91	Wilson, <i>et al.</i>			08/13/87
	K	4,969,197	11/06/90	Takaya			02/21/89
	L	4,885,783	12/05/89	Whitehead, <i>et al.</i>			04/10/87
	M	4,843,275	06/27/89	Radice			01/19/88
	N	4,518,555	05/21/85	Ravinet, <i>et al.</i>			06/14/83
	O	4,401,911	08/30/83	Ravinet, <i>et al.</i>			03/02/81
	P	4,400,634	08/23/83	Micheron			12/09/80
	Q	4,384,394	05/24/83	Lemonon, <i>et al.</i>			05/13/81
	R	3,403,234	09/24/68	Barnes, Jr.			09/11/64

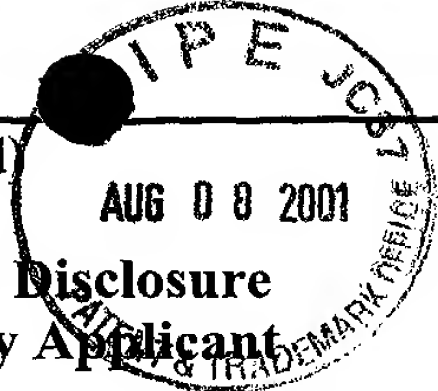
**Foreign Patent or Published Foreign Patent Application**

Examiner Initial	No.	Document No.	Publication Date	Country or Patent Office	Class	Sub-class	Translation	
							Yes	No
	S	WO 01/06575	01/25/01	PCT			X	
	T	WO 98/35529	08/13/98	PCT			X	
	U	WO 95/08905	03/30/95	PCT			X	

**Other Documents**

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	V	Ajluni, Cheryl, "Pressure Sensors Strive to Stay on Top, New Silicon Micromachining Techniques and Designs Promise Higher Performance", <i>Electronic Design - Advanced Technology Series</i> , October 3, 1994, pp. 67-74
	W	Anderson, R. A., "Mechanical Stress in a Dielectric Solid From a Uniform Electric Field", <i>The American Physical Society</i> , 1986, pp. 1302-1307
Examiner		Date Considered

Examiner: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

<b>Form 1449 (Modified)</b> <b>Information Disclosure</b> <b>Statement By Applicant</b> (Use Several Sheets if Necessary)		Atty Docket No. <b>SRI1P028/4431-2</b> Applicant: <b>Pelrine, et al.</b> Filing Date <b>02/07/01</b>	Application No.: <b>09/779,203</b>  Group <b>2858</b>
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### Other Documents

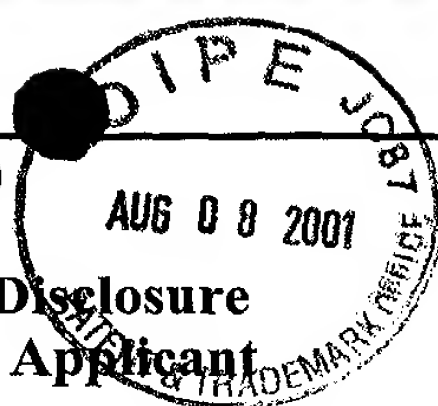
Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	X	Aramaki, S., S. Kaneko, K. Arai, Y. Takahashi, H. Adachi, and K. Yanagisawa. 1995. "Tube Type Micro Manipulator Using Shape Memory Alloy (SMA)," <i>Proceedings of the IEEE Sixth International Symposium on Micro Machine and Human Science</i> , Nagoya, Japan, pp. 115-120.
	Y	Ashley, S., "Smart Skis and Other Adaptive Structures", <i>Mechanical Engineering</i> , November 1995, pp. 77-81
	Z	Bar-Cohen, Yoseph, JPL, <i>WorldWide ElectroActive Polymers, EAP (Artificial Muscles) Newsletter</i> , Vol. 1, No. 1, June 1999.
	A1	Bar-Cohen, Yoseph, JPL, <i>WorldWide ElectroActive Polymers, EAP (Artificial Muscles) Newsletter</i> , Vol. 1, No. 2, December 1999.
	A2	Bar-Cohen, Yoseph, JPL, <i>WorldWide ElectroActive Polymers, EAP (Artificial Muscles) Newsletter</i> , Vol. 2, No. 1, July 2000.
	A3	Bar-Cohen, Yoseph, JPL, <i>WorldWide ElectroActive Polymers, EAP (Artificial Muscles) Newsletter</i> , Vol. 2, No. 2, December 2000.
	A4	Bar-Cohen, Yoseph, JPL, <i>WorldWide ElectroActive Polymers, EAP (Artificial Muscles) Newsletter</i> , Vol. 3, No.1, June 2001.
	A5	Bar-Cohen, Yoseph, JPL, <i>WorldWide Electroactive Polymer Actuators Webhub</i> webpages 1-7, <a href="http://ndea.jpl.nasa.gov/nasa-nde/lommas/eap/EAP-web.htm">http://ndea.jpl.nasa.gov/nasa-nde/lommas/eap/EAP-web.htm</a> , downloaded July 23, 2001.
	A6	Baughman, R., L. Shacklette, R. Elsenbaumer, E. Plichta, and C. Becht "Conducting Polymer Electromechanical Actuators," <i>Conjugated Polymeric Materials: Opportunities in Electronics, Optoelectronics and Molecular Electronics</i> , eds. J.L. Bredas and R.R. Chance, Kluwer Academic Publishers, The Netherlands, pp. 559-582, 1990
	A7	Baughman, R.H., L.W. Shacklette, and R.L. Elsenbaumer, E.J. Plichta, and C. Becht, "Micro electromechanical actuators based on conducting polymers", in <i>Molecular Electronics, Materials and Methods</i> , P.I. Lazarev (ed.), Kluwer Academic Publishers, pp. 267-289 (1991)
	A8	Bharti, V., Y. Ye, T.-B. Xu and Q. M. Zhang, "Correlation Between Large Electrostrictive Strain and Relaxor Behavior with Structural Changes Induced in P(VDF-TrFE) Copolymer by electron Irradiation," <i>Mat. Res. Soc. Symp. Proc.</i> Vol 541, pp. 653-659 (1999).
	A9	Bharti, V., Z.-Y. Cheng, S. Gross, T.-B. Xu, and Q. M. Zhang, "High electrostrictive strain under high mechanical stress in electron-irradiated poly(vinylidene fluoride-trifluoroethylene) copolymer," <i>Appl. Phys. Lett.</i> Vol. 75, 2653-2655 (October 25, 1999).
Examiner		Date Considered

Examiner: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.



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**Pelrine, et al.**Filing Date  
**02/07/01**Application No.:  
**09/779,203**Group  
**2858****Other Documents**

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	B1	Bharti, V., H. S. Xu, G. Shanthi, and Q. M. Zhang, "Polarization and Structural Properties of High Energy Electron Irradiated Poly(vinylidene fluoride-trifluoroethylene) Copolymer Films," to be published in <i>J. Appl. Phys.</i> (2000).
	B2	Bharti, V., X.-Z. Zhao, Q. M. Zhang, T. Romotowski, F. Tito, and R. Ting, "Ultrahigh Field Induced Strain And Polarization Response In Electron Irradiated Poly(Vinylidene Fluoride-Trifluoroethylene) Copolymer," <i>Mat. Res. Innovat.</i> Vol. 2, 57-63 (1998).
	B3	Bobbio, S., M Kellam, B. Dudley, S. Goodwin Johansson, S. Jones, J. Jacobson, F. Tranjan, and T. DuBois, "Integrated Force Arrays," in Proc. IEEE Micro ElectroMechanical Systems Workshop, Fort Lauderdale, Florida February 1993.
	B4	Bohon, K., and S. Krause, "An Electrorheological Fluid and Siloxane Gel Based Electromechanical Actuator: Working Toward an Artificial Muscle," to be published in <i>J. Polymer Sci., Part B. Polymer Phys.</i> (2000)
	B5	Brock, D. L., "Review of Artificial Muscle based on Contractile Polymers," MIT Artificial Intelligence Laboratory, A.I. Memo No. 1330, Nov. 1991.
	B6	Caldwell, D., G. Medrano-Cerda, and M. Goodwin, "Characteristics and Adaptive Control of Pneumatic Muscle Actuators for a Robotic Elbow," Proc. IEEE Int. Conference on Robotics and Automation, San Diego, California (8-13 May 1994).
	B7	Calvert, P. and Z. Liu, "Electrically stimulated bilayer hydrogels as muscles," Proceedings of the SPIE International Symposium on Smart Structures and Materials: Electro-Active Polymer Actuators and Devices, March 1-2, 1999, Newport Beach, California, USA, pp. 236-241.
	B8	Cheng, Z.-Y., H. S. Xu, J. Su, Q. M. Zhjg, P.-C. Wang, and A. G. MacDiarmid, "High performance of all-polymer electrostrictive systems," Proceedings of the SPIE International Symposium on Smart Structures and Materials: Electro-Active Polymer Actuators and Devices, March 1-2, 1999, Newport Beach, California, USA., pp. 140-148.
	B9	Cheng, Z.-Y., T.-B. Xu, V. Bharti, S. Wang, and Q. M. Zhang, "Transverse Strain Responses In The Electrostrictive Poly(Vinylidene Fluoride-Trifluorethylene) Copolymer," <i>Appl. Phys. Lett.</i> Vol 74, No. 13, pp. 1901-1903, March 29, 1999.
	B10	Chiarelli, P., A. Della Santa, D. DeRossi, and A. Mazzoldi. 1995. "Actuation Properties of Electrochemically Driven Polypyrrole Free-standing Films," <i>Journal of Intelligent Material Systems and Structures</i> , Vol. 6, pp. 32-37, January 1995
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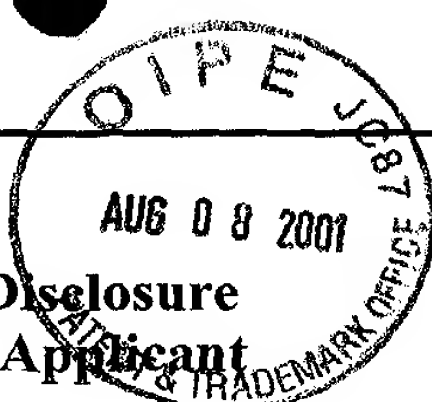
<b>Form 1449 (Modified)</b>  <b>Information Disclosure</b> <b>Statement By Applicant</b>  (Use Several Sheets if Necessary)	Atty Docket No. <b>SRI1P028/4431-2</b>	Application No.: <b>09/779,203</b>
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**Other Documents**

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	C1	De Rossi, D., and P. Chiarelli. 1994. "Biomimetic Macromolecular Actuators," <i>Macro-Ion Characterization, American Chemical Society Symposium Series</i> , Vol. 548, Ch. 40, pp. 517-530.
	C2	Dowling, K., <i>Beyond Faraday-Non Traditional Actuation</i> , available on the World Wide Web at <a href="http://www.frc.ri.cmu.edu/~nivek/OTH/beyond-faraday/beyondfaraday.html">http://www.frc.ri.cmu.edu/~nivek/OTH/beyond-faraday/beyondfaraday.html</a> , 9 pages, 1994
	C3	Egawa, S. and T. Higuchi, "Multi-Layered Electrostatic Film Actuator," <i>Proc. IEEE Micro Electra Mechanical Systems</i> , Napa Valley, California, pp. 166-171 (February 11-14, 1990).
	C4	Elhami, K., and B. Gauthier-Manuel, "Electrostriction Of The Copolymer Of Vinylidene-Fluoride And Trifluoroethylene," <i>J. Appl. Phys.</i> Vol. 77 (8), 3987-3990, April 15, 1995.
	C5	Flynn, Anita M., L.S. Tavrow, S.F. Bart, R.A. Brooks, D.J. Ehrlich, K.R. Udayakumar, and L.E. Cross. 1992. "Piezoelectric Micromotors for Microrobots," <i>IEEE Journal of Microelectromechanical Systems</i> , Vol.1, No.1, pp. 44-51 (March 1992); also published as <i>MIT AI Laboratory Memo 1269</i> , Massachusetts Institute of Technology (February 1991).
	C6	Full, R. J. and K. Meijer, "Artificial Muscles Versus Natural Actuators From Frogs To Flies," <i>Proceedings of the 7th SPIE Symposium on Smart Structures and Materials-Electroactive Polymers and Devices (EAPAD) Conference</i> , March 6-8, 2000, Newport Beach, California, USA, pp. 2-9.
	C7	Furuhata, T., T. Hirano, and H. Fujita, "Array-Driven Ultrasonic Microactuators," <i>Solid State Sensors and Actuators</i> , 1991, Digest of Tech. Papers, Transducers, pp. 1056-1059
	C8	Furukawa, T., and N. Seo., "Electrostriction as the Origin of Piezoelectricity in Ferroelectric Polymers," <i>Japanese J. Applied Physics</i> , Vol. 29, No. 4, pp. 675-680 (April 1990).
	C9	Gilbertson, R.G., and J.D. Busch. 1994. "Survey of Micro-Actuator Technologies for Future Spacecraft Missions," presented at the conference entitled "Practical Robotic Interstellar Flight: Are We Ready?" New York University and The United Nations, New York. (August 29 and September 1, 1994 ); also published on the World Wide Web at <a href="http://nonothinc.com/nanosci/microtech/mems/ten-actuators/gilbertson.html">http://nonothinc.com/nanosci/microtech/mems/ten-actuators/gilbertson.html</a> .
	C10	Goldberg, Lee, "Adaptive-Filtering Developments Extend Noise-Cancellation Applications," <i>Electronic Design</i> , February 6, 1995, pages 34 and 36
	C11	M. Greene and J. A. Willett, and Kornbluh, R., "Robotic systems," in <i>ONR Report 32198-2, Ocean Engineering and Marine Systems 1997 Program</i> (Dec. 1997)
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	Applicant: <b>Pelrine, et al.</b>	
	Filing Date <b>02/07/01</b>	Group <b>2858</b>



### Other Documents

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	D1	Heydt, R., R. Pelrine, J. Joseph, J. Eckerle, and R. Kornbluh. "Acoustical Performance of an Electrostrictive Polymer Film Loudspeaker", <i>Journal of the Acoustical Society of America</i> Vol. 107, pp. 833-839 (Feb. 2000).
	D2	Heydt, R., R. Kornbluh, R. Pelrine, and B. Mason, "Design and Performance of an Electrostrictive Polymer Film Acoustic Actuator", <i>Journal of Sound and Vibration</i> (1998)215(2), 297-311.
	D3	Hirano, M., K. Yanagisawa, H. Kuwano, and S. Nakano, "Microvalve with Ultra-low Leakage," Tenth Annual International Workshop on Micro Electromechanical Systems, Nagoya, Japan, <i>IEEE Proceedings</i> (January 26-30, 1997), pp. 323-326.
	D4	Hirose, S., Biologically Inspired Robots: Snake-like Locomotors and Manipulators, " <i>Development of the ACM as a Manipulator</i> ", Oxford University Press, New York, 1993, pp.170-172.
	D5	Hunter, I., S. Lafontaine, J. Hollerbach, and P. Hunter, "Fast Reversible NiTi Fibers for Use in MicroRobotics," <i>Proc. 1991 IEEE Micro Electro Mechanical Systems-MEMS '91</i> , Nara, Japan, pp.166-170.
	D6	Hunter, I.W., and S. Lafontaine, "A Comparison of Muscle with Artificial Actuators", <i>Technical Digest of the IEEE Solid-state Sensor and Actuator Workshop</i> , Hilton Head, South Carolina, June 22-25, 1992, pp.178-185.
	D7	Jacobsen, S., Price, R., Wood, J, Rytting, T., and Rafaelof, M., "A Design Overview of an Eccentric-Motion Electrostatic Microactuator (the Wobble Motor)", <i>Sensors and Actuators</i> , 20 (1989) pages 1-16
	D8	Kaneto, K., M. Kaneko, Y. Min, and A.G. MacDiarmid. 1995. "'Artificial Muscle': Electromechanical Actuators Using Polyaniline Films," <i>Synthetic Metals</i> 71, pp. 2211-2212, 1995
	D9	Kawamura, S., K. Minani, and M. Esashi, "'Fundamental Research of Distributed Electrostatic Micro Actuator," <i>Technical Digest of the 11th Sensor Symposium</i> , pp. 27-30(1992).
	D10	Kondoh Y., and T. Ono. 1991. "Bimorph Type Actuators using Lead Zinc Niobate-based Ceramics," <i>Japanese Journal of Applied Physics</i> , Vol. 30, No. 9B, pp. 2260-2263, September 1991.
	D11	Kornbluh, R., R. Pelrine, R. Heydt, and Q. Pei, "Acoustic Actuators Based on the Field-Activated Deformation of Dielectric Elastomers," (2000)
	D12	Kornbluh, R., G. Andeen, and J. Eckerle, "Artificial Muscle: The Next Generation of Robotic Actuators," presented at the Fourth World Conference on Robotics Research, SME Paper M591-331, Pittsburgh, PA, September 17-19, 1991.
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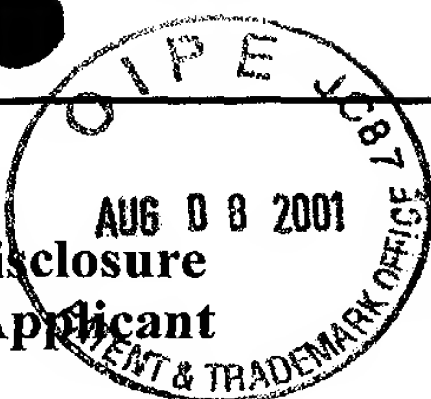
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	Filing Date	Group
	<b>02/07/01</b>	<b>2858</b>

#### Other Documents

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	E1	Kornbluh, R., R. Pelrine, J. Joseph, "Elastomeric Dielectric Artificial Muscle Actuators for Small Robots," <i>Proceedings of the Third IASTED International Conference on Robotics and Manufacturing</i> , June 14-16, 1995, Cancun, Mexico.
	E2	Kornbluh, R., Pelrine, R., Eckerie, J., Joseph, J., "Electrostrictive Polymer Artificial Muscle Actuators", IEEE International Conference on Robotics and Automation, Leuven, Belgium, 1998
	E3	Kornbluh, R., R. Pelrine, Jose Joseph, Richard Heydt, Qibing Pei, Seiki Chiba, 1999. "High-Field Electrostriction Of Elastomeric Polymer Dielectrics For Actuation", Proceedings of the SPIE International Symposium on Smart Structures and Materials: Electro-Active Polymer Actuators and Devices, March 1-2, 1999, Newport Beach, California, USA. pp. 149-161.
	E4	Kornbluh, R. D and R. E. Pelrine., "Dexterous Multiarticulated Manipulator with Electrostrictive Polymer Artificial Muscle," ITAD-7247-QR-96-175, SRI Project Number 7247, Prepared for: Office of Naval Research, November 1996
	E5	Kornbluh, R., R. Pelrine, Q. Pei, S. Oh, and J. Joseph, 2000. "Ultrahigh Strain Response of Field-Actuated Elastomeric Polymers," Proceedings of the 7th SPIE Symposium on Smart Structures and Materials-Electroactive Polymers and Devices (EAPAD) Conference, March 6-8, 2000, Newport Beach, California, USA, pp. 51-64.
	E6	Kornbluh, R., Pelrine, R. Joseph, J., Pei, Q. and Chiba, S., "Ultra-High Strain Response of Elastomeric Polymer Dielectrics", Proc. Materials Res. Soc., Fall meeting, Boston, MA, pages 1-12, December 1999
	E7	Ktech's PVDF Sensors, <a href="http://www.ktech.com/pvdf.htm">http://www.ktech.com/pvdf.htm</a> , 06/06/2001, pp. 1-5.
	E8	Lang, J, M. Schlect, and R. Howe, "Electric Micromotors: Electromechanical Characteristics," Proc. IEEE Micro Robots and Teleoperators Workshop, Hyannis, Massachusetts (November 9-11, 1987).
	E9	Liu, Y., T. Zeng, Y.X. Wang, H. Yu, and R. Claus, "Self-Assembled Flexible Electrodes on Electroactive Polymer Actuators," Proceedings of the SPIE International Symposium on Smart Structures and Materials: Electro-Active Polymer Actuators and Devices, March 1-2, 1999, Newport Beach, California, USA., pp. 284-288.
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	Filing Date <b>02/07/01</b>	



### Other Documents

Examiner Initial	No.	Author, Title, Date, Place (e.g. Journal) of Publication
	F1	Liu, C., Y. Bar-Cohen, and S. Leary, "Electro-statically stricted polymers (ESSP)," Proceedings of the SPIE International Symposium on Smart Structures and Materials: Electro-Active Polymer Actuators and Devices, March 1-2, 1999, Newport Beach, California, USA., pp. 186-190.
	F2	Lawless, W. and R. Arenz, "Miniature Solid-state Gas Compressor," <i>Rev. Sci Instrum.</i> , 58(8), pp.1487-1493, August 1987
	F3	Martin, J. and R. Anderson, 1999. "Electrostriction In Field-Structured Composites: Basis For A Fast Artificial Muscle?", <i>Journal of Chemical Physics</i> , Vol. 111, no. 9, pp.4273-4280, September 1, 1999
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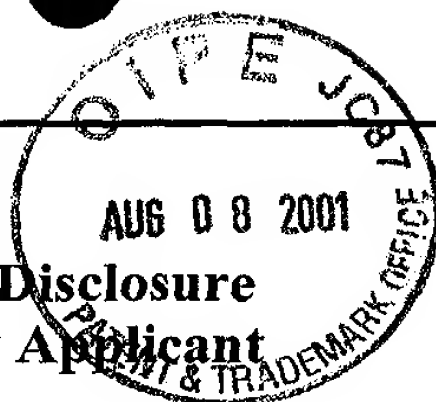
<b>Form 1449 (Modified)</b>  <b>Information Disclosure Statement By Applicant</b>  (Use Several Sheets if Necessary)	Atty Docket No. <b>SRI1P028/4431-2</b>	Application No.: <b>09/779,203</b>
	Applicant: <b>Pelrine, et al.</b> Filing Date <b>02/07/01</b>	Group <b>2858</b>

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	G1	Pei, Q., O. Inganäs, and I. Lundström, "Bending Bilayer Strips Built From Polyaniline For Artificial Electrochemical Muscles," <i>Smart Materials and Structures</i> , Vol.2, pp. 16., January 22, 1993
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	Applicant: <b>Pelrine, et al.</b> Filing Date <b>02/07/01</b>	Group <b>2858</b>



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**Other Documents**

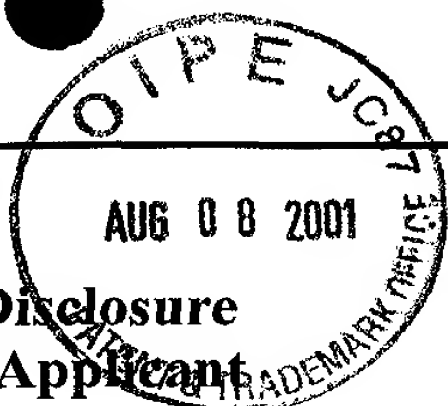
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Form 1449 (Modified)

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